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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 159.

SCAB IN SHEEP.

BY

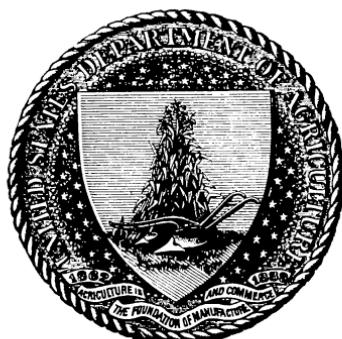
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June 10, 1903.

SIR: I have the honor to transmit an article entitled "Scab in sheep," and to recommend the publication of the same as a Farmers' Bulletin. The subject has been treated in detail in Bulletin No. 21 (revised) of the Bureau of Animal Industry, and the present paper is condensed from that bulletin. In this publication will be found a description of common scab of sheep, descriptions of several kinds of dipping plants suitable for use on small and on large farms, directions for preparing certain homemade dips, and directions for dipping. Remedies for scab are also given which have been tried and found most efficacious by this Bureau. It is believed that the republication of the information as a Farmers' Bulletin will largely increase its usefulness by supplying a popular demand, due to the prevalence of sheep scab in various parts of the United States.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SCAB IN SHEEP.

INTRODUCTION.

The disease commonly called sheep scab is one of the oldest known, most prevalent, and most injurious maladies which affect sheep. It is a contagious skin disease caused by a parasitic mite. Investigation has shown that the disease is not hereditary, as the parasites which cause it live on the external surface of the body. It is possible, however, for a lamb to become infected from a scabby mother at the moment of birth or immediately after. The treatment must consist of external applications for the destruction of the parasites and not internal remedies to "purify the blood."

The disease is one of the most serious drawbacks to the sheep industry and results in enormous financial losses. The losses are due to the shedding of the wool, failure of condition, and the death of the sheep. Yet, despite its insidious nature, its ease of transmission, its severe effects, and its prevalence in certain localities, it is a disease which yields readily to proper treatment. If all the sheep owners of the country would dip sheep regularly and thoroughly, there is no reason why this scourge should not be totally eradicated from the United States.

In many cases, particularly among owners of small flocks, there are erroneous ideas prevalent regarding the exact nature of the disease and the methods by which it may be eradicated. It is to meet the demand for information on the subject that this bulletin has been prepared.

CAUSE OF COMMON SHEEP SCAB.

Sheep scab is a strictly contagious disease. Common sheep scab is caused by that species of mites technically known as *Psoroptes communis*. Parasites of this species cause scab in horses, cattle, sheep, goats, and rabbits; but for each of these species of animals there appears to be a distinct variety of this parasite. Although it is more or less difficult to distinguish between these varieties, they differ

somewhat in size; also it is found that the *Psoroptes communis* of the sheep does not cause scab of the horse, ox, or rabbit; nor, on the other hand, does the *Psoroptes communis* of the horse, ox, or rabbit cause scab of the sheep. Naturalists, therefore, distinguish the parasite of sheep scab by the name *Psoroptes communis* var. *ovis*. (See figs. 1 and 2.)

The parasite of this disease is one of the larger mites, and is quite easily seen with the naked eye. The adult female is about one-fortieth inch long and one-sixtieth inch broad; the male is one-fiftieth inch

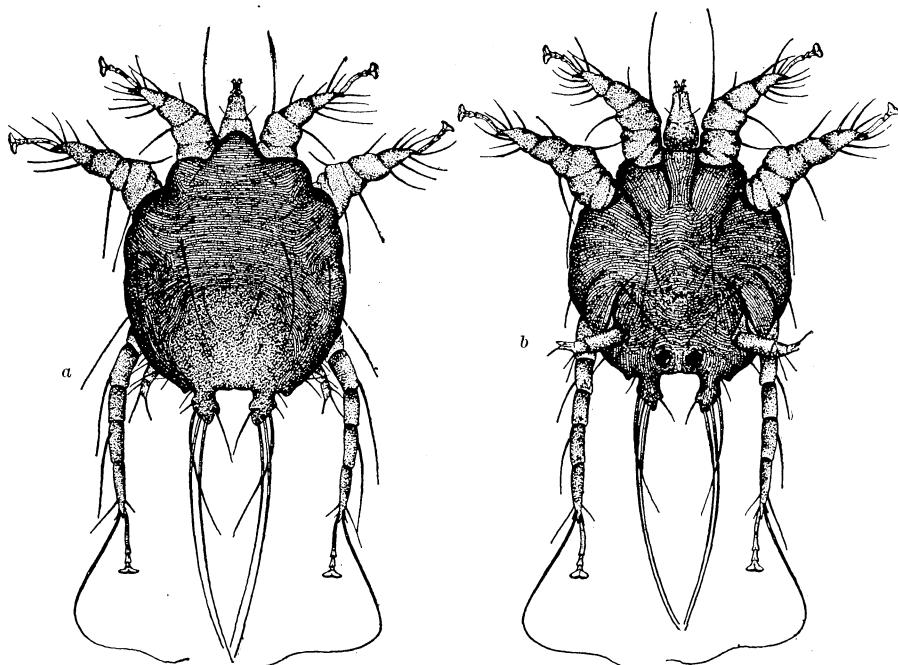


FIG. 1.—Adult male parasite of common sheep scab (greatly enlarged): *a*, View from above; *b*, view from below.

long and one-eighthieth inch broad. These mites are discovered more readily and more clearly on a dark than on a light background, and for that reason the crusts from the affected skin are often placed upon black paper and kept in the sunshine for a few minutes in order to reveal the parasites crawling about.

The Psoroptes inhabits the regions on the surface of the body which are most thickly covered with wool—that is, the back, the sides, the rump, and the shoulders. Its presence is the cause of the true body scab on sheep, and of all parasitic mites it produces the most serious injuries.

DESCRIPTION OF COMMON SHEEP SCAB.

The mites of common, or body, scab—that is, the *Psoroptes*—prick the skin of the animal to obtain their food, and probably insert a

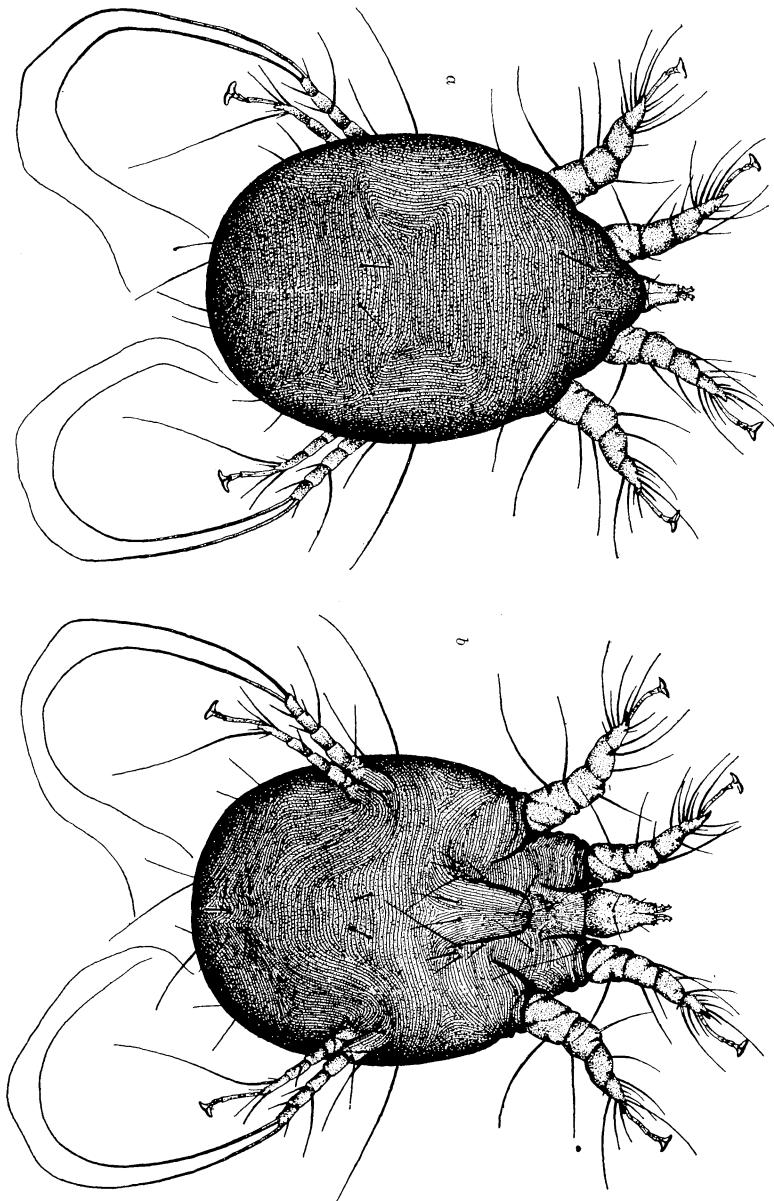


FIG. 2.—Adult female parasite of common sheep scab (greatly enlarged): *a*, View from above; *b*, view from below.

poisonous saliva in the wound. Their bites are followed by intense itching, with irritation, formation of papules, inflammation, exudation

of serum, and the formation of crusts, or scabs, under and near the edge of which the parasites live. As the parasites multiply they seek the more healthy parts, spreading from the edges of the scab already formed, thus extending the disease. The sheep are restless; they scratch and bite themselves, and rub against posts, fences, or stones, or against other members of the flock. This irritation is particularly noticeable after the animals have been driven, for the itching is more intense when the sheep become heated. The changes in the skin

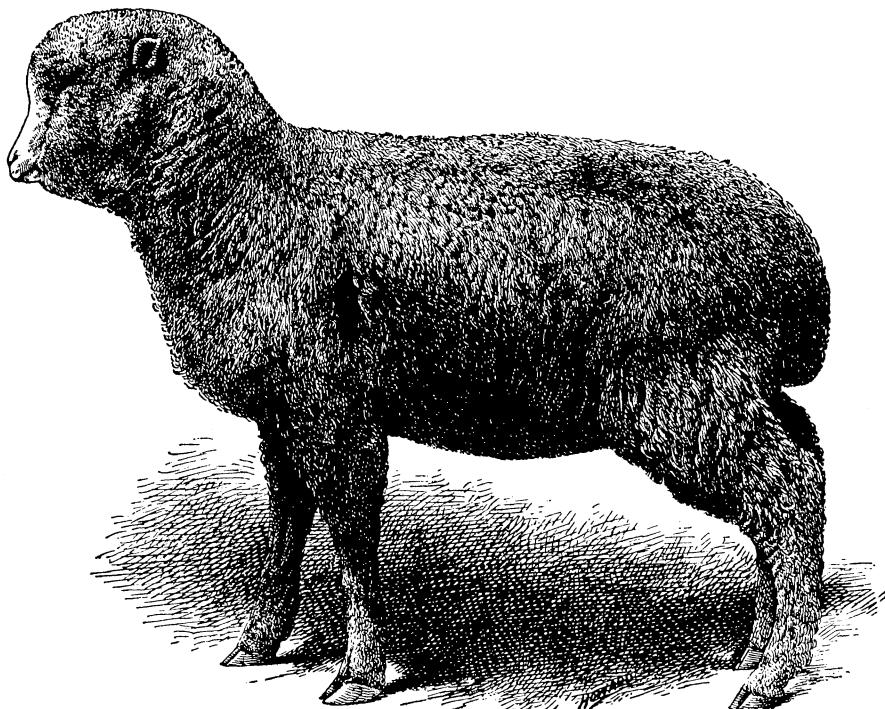


FIG. 3.—A comparatively early case of common scab, showing a bare spot and a tagging of the wool.

naturally result in the falling of the wool. At first slender "tags" are noticed; the fleece assumes the condition known as "flowering;" it looks tufty or matted, and the sheep pulls out portions with its mouth, or leaves tags on the objects against which it rubs. Scabs fall and are replaced by thicker and more adherent crusts. The skin finally becomes more or less bare, parchment-like, greatly thickened, furrowed, and bleeding in the cracks. With shorn sheep, especially, a thick, dry, parchment-like crust covers the greatly tumified skin. Ewes may abort or bear weak lambs.

PARTS OF BODY AFFECTED BY SCAB.

When sheep are kept in large numbers the chances for infection are naturally greater, and the disease may begin on almost any part of the body. Generally, however, it affects the parts which are covered with wool. When the sheep are fat and the wool has a large amount of yolk, the progress of the disease may be slow; usually beginning on the upper part of the body, withers, and back, it extends slowly, but none the less surely and in ever-increasing areas, to the neck, sides, flanks, rump, etc. In two or three months the entire body may be affected. (See figs. 3 and 4.)

CONTAGIOUSNESS OF SCAB.

Common scab is exceedingly contagious from one sheep to another, and may in some cases show itself within about a week after healthy

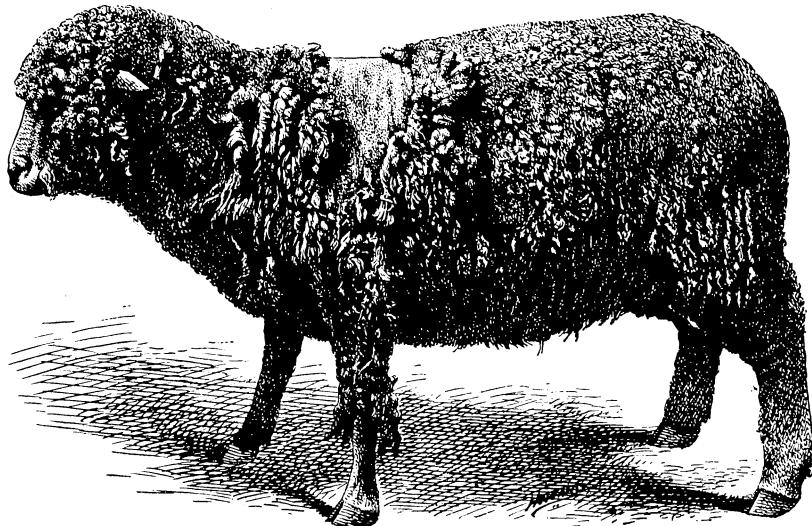


FIG. 4.—An advancing case of common scab.

sheep have been exposed to infection. The contagion may be direct, by contact of one sheep with another; or indirect, from tags of wool, or from fences, posts, etc., against which scabby sheep have rubbed, or from the places where the sheep have been "bedded down." One attack of scab does not protect sheep from later attacks. Transmitted to man, sheep scab may produce a slight spot on the skin, a point which is sometimes taken advantage of for the purpose of diagnosis. In case of suspected scab, one of the crusts is bound lightly on the arm. After a short time an itching sensation is felt and the mites are found on the skin. Transmitted to horses, cattle, or goats, common sheep scab fails to develop.

CHANCES FOR RECOVERY FROM SCAB.

Cases of apparent spontaneous recovery are rare. Usually when proper methods of treatment are not adopted the disease increases, leads to anæmia, emaciation, exhaustion, and death, and may result in a loss of from 10 to 80 per cent of the flock. Scab is favored by seasons when the wool is longest, and by huddling or overcrowding the animals; also race, energy, temperament, age, state of health, length, fineness, and abundance of wool, and the hygienic conditions of the surroundings influence the course and termination of the disease. Young, weak, closely inbred animals, and those with long, coarse wool will most quickly succumb. Unhealthy localities, damp climate, and poorly ventilated sheds favor the disease. Pure or mixed Merino sheep succumb sooner than certain other breeds. The mortality varies according to conditions, but is highest in autumn and winter. When owners are careless the death rate may be very high; if untreated the sheep may die in two to three months. Hygienic conditions, good food, and cool, dry atmosphere tend to check the disease. Sheep sheds should accordingly be well ventilated and open to light and sunshine. With proper attention to hygienic conditions and thorough dipping, a positive cure can be guaranteed.

VITALITY OF THE SCAB PARASITE.

Taken from the sheep, the mites possess a remarkable vitality. It is generally stated that, kept at a moderate temperature on portions of scab, the adults may live from four to twenty days, but they will occasionally live much longer; cases are on record where they have lived three, four, or even six weeks when separated from sheep; if the atmosphere is dry they will generally die in about fifteen days; but death is often only apparent, for the mites may sometimes be revived by warmth and moisture even after six or eight weeks; the fecundated females are especially tenacious of life. Various rather contradictory statements may be found regarding their resistance to cold. Krogmann states that they may live at a temperature of -10° C. ($+14^{\circ}$ F.) for twenty-eight days; other authors claim that the mites die in two hours at 47° F.; still other authors, that they die at 50° C. (122° F.). They are said to have been kept alive in cold water for six days and in warm water for ten days. Several authors admit, however, that the parasites are usually killed by a soaking rain; though it is claimed that in damp, dark stables they "may live for months."

Experience has shown that in some cases apparently healthy sheep have become infected in places where no sheep have been kept for four, eight, twelve, or even twenty-four months. The conditions underlying this infection are not thoroughly understood. Possibly some of the eggs have retained their vitality a long time and then hatched out; possibly the vitality of the fecundated female has also played a rôle;

while it is not at all improbable that an entirely new infection has accidentally been introduced by birds or other animals. Certain authors of high standing scout the idea that birds can introduce an infection of scab, but there is no reason why birds should not do this, and there are some reasons for believing that they do. It has been noticed at the experiment station farm of the Bureau, for instance, that crows delight in perching on the backs of scabby sheep and picking at the scab; while so doing it is only natural that small tags of wool would adhere to their feet, and thus scatter scab. The fact that snails cling to birds' feet and are carried long distances is too well established to need discussion, and it is very probable that many of the cases where sheep are supposed to have become infected with scab on pastures which have not been occupied for one or two years are in reality cases of fresh infection by means of birds. From the data at hand, while it may be admitted that in some cases, under favorable conditions, the mites may live from spring to fall, it is scarcely within the limits of probability that either the scab mites or their eggs will live through a winter when separated from the sheep and exposed to the elements.

All matters connected with the vitality of the scab mite have an important bearing in explaining cases of indirect infection on roads over which scabby sheep have been driven, or in fields and sheds where they have been kept. From the facts now at hand, the following important rules can be presented:

(1) Scabby sheep should never be driven upon a public road; (2) sheds in which scabby sheep have been kept should be thoroughly cleaned, disinfected, and aired, and should be left unused for *at least four weeks* (better two months) before clean sheep are placed in them; (3) fields in which scabby sheep have been kept should stand vacant *at least four weeks* (better six or eight) before being used for clean sheep; (4) a drenching rain will frequently serve to disinfect a pasture, but it is well to whitewash the posts against which scabby sheep have rubbed. Even after observing the precautions here given it is not possible to absolutely guarantee that there will be no reinfection, but the probabilities are against it.

LIFE HISTORY OF THE SCAB PARASITE.

A study of the life history of the scab parasite is necessary in order to determine several important points of practical value, such as the proper time for the second dipping, etc.

The female mite lays about 15 to 24 eggs on the skin, or fastened to the wool near the skin; a six-legged larva is hatched; these larvæ cast their skin and become mature; the mites pair and the females lay their eggs, after which they die. The exact number of days required for each stage varies somewhat, according to the writings of different authors, a fact which is probably to be explained by individual varia-

tion, and by the conditions under which the observations and experiments were made. Thus Gerlach, in his well-known work (1857), estimates about fourteen to fifteen days as the period required for a generation of mites from the time of pairing to the maturity of the next generation. He divides this time as follows: Under ordinary conditions the eggs hatch in three to four days, although two authors allow ten to eleven days for the egg stage; three or four days after birth the six-legged larvæ molt and the fourth pair of legs appear; this fourth pair are always present when the mites are two-thirds the size of the adults; when seven to eight days old the mites are mature and ready to pair; several (three or four) days are allowed for pairing; another generation of eggs may be laid fourteen to fifteen days after the laying of the first generation of eggs. Without going into all of the other observations on these points, it may be remarked that the eggs may not hatch for six or seven days; the six-legged larvæ may molt when three to four days old, and become mature; after pairing a second molt takes place, lasting four to five days; a third molt follows immediately, then eggs are laid and the adults die; in some cases there is a fourth molt, but apparently without any further production of eggs. Accepting Gerlach's estimate of fifteen days as an average for each generation of 10 females and 5 males, in three months' time the sixth generation would appear and consist of about 1,000,000 females and 500,000 males.

Several practical lessons are to be drawn from these figures: First, it is seen that the parasites increase very rapidly, so that if scab is discovered in a flock, the diseased sheep should immediately be isolated; second, if new sheep are placed in a flock, they should either first be dipped, as a precautionary measure, or they should at least be kept separate for several weeks to see whether scab develops; third, since the chances for infection are very great, the entire flock should be treated, even in case scab is found only in one or two animals; fourth, as dipping is not certain to kill the eggs, the sheep should be dipped a second time, the time being selected between the moment of the hatching of eggs and the moment the next generation of eggs is laid. As eggs may hatch between three and seven, possibly ten or eleven, days, and as fourteen to fifteen days are required for the entire cycle, the second dipping should take place after the seventh day, but before the fourteenth day; allowing for individual variation and variation of conditions, the tenth, eleventh, or twelfth day will be the best time to repeat the dipping.

CONDITIONS WHICH MAY BE MISTAKEN FOR SCAB.

Any parasite or condition which causes an itching, and thus leads the sheep to scratch themselves, or any abnormal condition of the skin, may be temporarily mistaken for scab; but if the rule is held in mind

that no scab is possible without the presence of the specific parasites, it will be easily determined whether scab is present or not. The following are the more important cases to be considered:

(1) **Itching due to other parasites**, such as the common "sheep tick," true ticks, and lice, may be distinguished from scab by finding the parasites. The dipping used for treating scab will also kill sheep ticks and lice. (See figs. 5, 6, and 7 for some parasites causing conditions resembling scab.)

(2) **Inflammation of the sebaceous glands**.—This may be mistaken for common scab. It appears most frequently in autumn. There is a severe itching, the skin is red and sensitive, and is

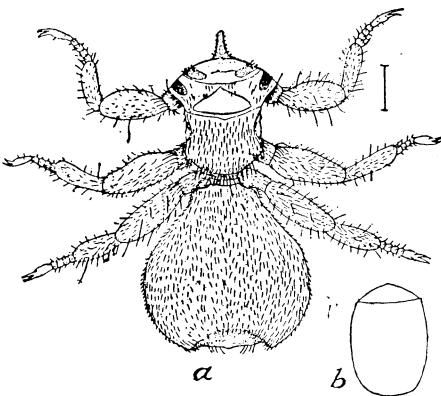


FIG. 5.—Adult sheep tick (a) and puparium (b) (*Metophagus orinus*)—enlarged. (After Osborn, 1896; Bul. No. 5, Div. Entomology, U. S. Dept. Agr.).

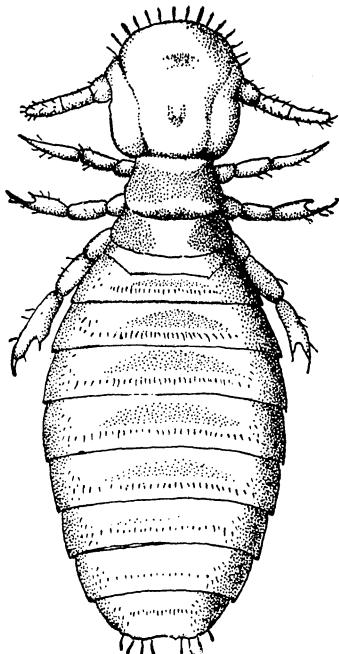


FIG. 6.—Adult female sheep louse—enlarged. (After Osborn, 1896; Bul. No. 5, Div. Entomology, U. S. Dept. Agr.)

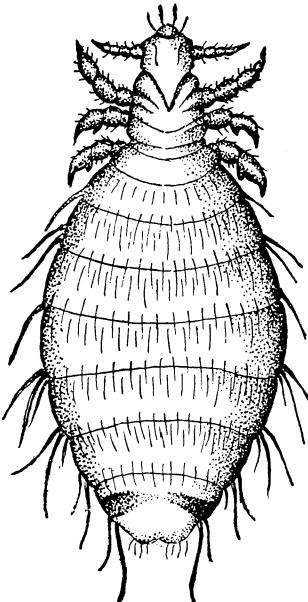


FIG. 7.—Adult female sheep foot louse—enlarged. (After Osborn, 1896; Bul. No. 5, Div. Entomology, U. S. Dept. Agr.)

covered with a strong-smelling, yellowish, viscid yolk; tufts of wool may be shed. It may be cured, after shearing, with any starchy lotion.

(3) **Rain rot.**—In rainy weather an eruption may appear on the skin which might be mistaken for scab. There is, however, no parasite present; itching is absent, and the trouble disappears when dry weather comes.

TREATMENT OF SCAB.

Proper hygienic conditions alone, though of importance in connection with the subject of treatment, can not be relied upon to cure scab. The only rational treatment consists in using some external application which will kill the parasites. Formerly medicines were given internally, and even within a few years past it has been claimed that feeding sulphur to sheep will cure the disease. The statements regarding sulphur were such as to lead the Department to try the experiment, which, however, was soon abandoned as unsuccessful. The external application of scab cures is in various ways made known as hand dressing, hand curing, spotting, pouring, smearing, and dipping. Of these methods, dipping is by far the most satisfactory.

HAND APPLICATIONS.

While common scab is the disease treated in this bulletin, as a matter of information, it may be stated that in case of head scab, or in light cases of foot scab, which appear to be rather rare, hand applications may be resorted to, and will frequently suffice. A nonpoisonous ointment may be made by taking 4 ounces of oil of turpentine, 6 ounces of flowers of sulphur, and 1 pound of lard. Mix the ingredients at a gentle heat, and rub in well with the hands or with a brush, at the same time breaking the crusts. The simple sulphur ointment may be made of 1 part of sulphur and 4 parts of lard; one-fourth part of mercurial ointment may be added. Few remedies are so useful in mange in dogs, ringworm, and other itching complaints as sulphur iodide, and it may well be given a trial on head scab. It is prepared as follows: Mix in a nonmetallic vessel, as a porcelain mortar, 4 ounces of iodine with 1 ounce of sublimed sulphur, gently heating the mixture until it liquefies; the red-brown liquid upon cooling becomes a gray-black crystalline mass, insoluble in water, but soluble in glycerine and fats, with 8 or 10 parts of which it is mixed for ointments or liniments. An ointment of flowers of sulphur and carbolated vaseline would also probably give good results. One author advises for head scab and foot scab a mixture consisting of 1 part of mercurial ointment and 11 parts of sulphur ointment. Foot scab and head scab would also probably respond to treatment with the various dips used for common scab.

Hand dressing is not recommended for common scab; in fact, it must be looked upon as directly responsible for a considerable amount of the disease, since it is too often relied upon to cure the disease,

while in reality it is only a palliative. The only condition under which hand dressings can be advised is in case scab is discovered in one or two sheep of a flock during severe winter weather, when dipping would be impracticable. In that event, the infected sheep should be immediately isolated from the flock; and they might be hand dressed, if desired, in order to hold the disease in check. It can not be too strongly insisted upon that "pouring," "spotting," etc., are only expensive and temporizing methods of dealing with scab.

"Pouring" is done as follows: Part the wool on the back by making a furrow with the finger from the head to the tail; furrows are also made along the shoulders and thighs to the legs, and on the sides; pour the ointment or dip in these furrows. A still better plan is to pour the warm dip from a coffeepot or teapot directly on the affected parts, rubbing it well in with the hand, a brush, or a corncob. It must be repeated for emphasis, however, that such treatment can not be relied upon, and should be used only in emergency cases when dipping is impracticable.

A mercurial ointment may be made as follows: (A) Dissolve 1 pound of resin in one-half pint of oil of turpentine; (B) mix 1 pound of mercurial ointment with 6 pounds of lard, with gentle heat; and (C) when cool, mix the two compounds, A and B. It should be remembered that mercurial ointments are not unattended with danger, and on this account it is better to prepare a small amount of dip and pour it on the affected part as described above.

DIPPING.

By far the most rational and satisfactory and the cheapest method of curing scab is by dipping the sheep in some liquid which will kill the parasites. The dipping process is as follows:

(1) Select a dip containing sulphur. If a prepared "dip" is used which does not contain sulphur, it is always safer to add about $16\frac{1}{2}$ pounds of sifted flowers of sulphur to every 100 gallons of water, especially if, after dipping, the sheep have to be returned to the old pastures.

(2) Shear all the sheep at one time, and immediately after shearing confine them to one-half the farm for two to four weeks. Many persons prefer to dip immediately after shearing.

(3) At the end of this time dip every sheep (and every goat also, if there are any on the farm).

(4) Ten days later dip the entire flock a second time.

(5) After the second dipping, place the flock on a portion of the farm from which they have been excluded during the previous four or five weeks.

(6) Use the dip at a temperature of 100° to 110° F.

(7) Keep each sheep in the dip for two minutes by the watch—do not guess at the time—and duck its head at least once.

(8) Be careful in dipping rams, as they are more likely to be overcome in the dip than are the ewes.

(9) Injury may, however, result to pregnant ewes, which must, on this account, be carefully handled. Some farmers arrange a stage, with sides, to hold the pregnant ewes, which is lowered carefully into the vat, and raised after the proper time.

(10) In case a patent or proprietary dip, especially an arsenical dip, is used, the directions given on the package should be carried out to the letter.

CHOICE OF A PREPARATION FOR DIPPING.

Numerous different sheep dips are recommended by various parties, and undoubtedly many of them are efficacious; few can be named which some persons do not consider far superior, and other persons consider far inferior, to all other dips known; few can be found which have not cured cases of scab, and probably none can be named with which failures have not been reported. Under these circumstances the farmer should not be deceived by exaggerated statements in either extreme. He should know the composition of the material he is using. If he desires to use a ready-made dip, let him inform himself of its exact nature in order to prevent impositions and guard against dangers. He would do well to refuse to purchase any prepared mixture which does not bear on each package a printed statement of the ingredients and their proportions, which the manufacturer guarantees are to be found in that package; he would also do well to avoid any compound which irresponsible parties advertise as “the only sure cure for scab,” etc.

SUCCESS WITH HOMEMADE DIPS.

While a remedy should not be condemned simply because it is prepared ready for use, the value of homemade dips is insisted upon, and attention is called to the fact that it was almost entirely through homemade mixtures that scab was eradicated from certain of the Australian colonies. As statements have been made that scab was eradicated from the English colonies by killing the scabby sheep or by the use of prepared dips, it may be well to say that these statements are erroneous. An act was passed in New South Wales about 1851 for the slaughter of scabby sheep, and a few remaining straggling flocks were destroyed under that act; but on the reappearance of scab in that colony in 1863 by infection from Victoria, the act was repealed, and the whole of the scabby sheep, about 400,000, were completely cured by means of tobacco and sulphur.

IMPORTANCE OF PROPER USE OF DIP.

Whatever dip is selected, the farmer should not forget that there are two ways of using it. One way is to prepare and use it in accordance with the directions given; the other way is to attempt to economize time, labor, or money by using it in weaker proportion than advised, by hurrying the sheep through the swim, or by later placing the dipped sheep under unfavorable conditions. If the former method is adopted with any of the established dips, the treatment ought to be followed with favorable results; if the latter method is adopted, the farmer himself must assume the responsibility of failure, no matter what remedy he decides to use. Every farmer should therefore remember that when he has decided upon the dip he is to use, his work has only begun; to use it properly is fully as important as to use a dip at all.

PRELIMINARY QUESTIONS IN CHOOSING A DIP.

The homemade dips which are most commonly used have either tobacco or sulphur as their basis, while the prepared dips contain tobacco, sulphur, arsenic, carbolic acid, etc., as curative agents.

In selecting a dip several points should be considered: First of all, the question of expense will naturally arise; next, the question as to whether or not scab actually exists in the flock to be dipped, or whether or not the dipping is more of a precautionary matter, or for the sake of cleansing the animal's skin. The facilities at hand, the setback to the sheep, and the length of the wool are also matters for consideration, as well as the pastures into which the dipped sheep are to be placed. Notwithstanding statements to the effect that a given dip can be used under all conditions, the above questions are evidently important.

Expense.—In estimating the expense one should consider not only the actual outlay for the ingredients of the ooze, but the cost of fuel and labor, the injury, if any, to the sheep, and the liability of not curing the disease. It is much more economical to use an expensive dip and cure scab than it is to use a cheap dip and fail to cure it. To illustrate with a well-known homemade dip: A lime and sulphur dip may be made in ten to thirty minutes, with but little fuel and little labor, which may or may not cure the disease, and which will surely do great injury to the wool; or a lime-and-sulphur dip may be made in several hours' time, at the expense of considerable fuel, labor, and patience, which can be relied upon to cure scab, and which will do little or no injury to the wool. The first dip is cheap, but not economical; the second dip is more expensive, but more economical.

Does scab exist in the flock?—Every farmer should ask himself this question before he selects his dip. If scab does not actually exist and the wool is long, the dipping in this case simply being a matter of

precaution, it is best not to select a dip containing lime. The use of the lime-and-sulphur dips is therefore not advised simply as precautionary dressing for healthy long-wooled sheep. On the contrary, the use of any dip containing lime, as a precautionary measure, should be avoided.

The facilities at hand for preparing dip.—If fuel is very scarce, so that it is impracticable to boil the mixture for at least two hours, the lime-and-sulphur dips should not be selected. A tobacco-and-sulphur dip, as well as many of the better proprietary dips, can be made without the necessity of lengthy boiling, and should be given preference whenever facilities for boiling are not at hand.

The length of the wool is discussed under the head “Lime-and-sulphur dips” (p. 21).

The pastures.—In case it is necessary to place the dipped sheep on the same pastures they occupied before being dipped, it is always best to use a dip containing sulphur. If a proprietary dip is selected under those circumstances, it is suggested that sulphur be added, about 1 pound of flowers of sulphur to every 6 gallons of dip. In case it is possible to utilize fresh pastures after dipping, the use of sulphur is not so necessary, but is always advisable. The object in using sulphur is to place in the wool a material which will not evaporate quickly, but will remain there for a longer period of time than the scab parasites ordinarily remain alive away from their hosts. By doing this the sheep are protected against reinfection.

KINDS OF DIPS.

Sulphur is one of the oldest known remedies for scab. As a scab eradicator it must be placed among the best substances at our disposal. It is one of the constituents of certain proprietary dips, but its use to the farmer is best known in the tobacco-and-sulphur dip and in the lime-and-sulphur dip. These homemade mixtures, as already shown, are the two dips which have played the most important rôles in the eradication of scab from certain English colonies, and their use, especially the use, *as well as the abuse*, of lime and sulphur, is quite extensive in this country.

THE TOBACCO-AND-SULPHUR DIP.

The formula, as given here and as adopted by the New South Wales sanitary authorities, appears to have first been proposed in 1854 by Mr. John Rutherford. Regarding its success in Australia, Dr. Bruce, chief inspector of sheep for New South Wales, makes the following statements:

On the Hopkins Hill Station Mr. Rutherford, with two dressings of these ingredients, then cured over 52,000 sheep which had been infected for eighteen months; and

he also subsequently cured with two dippings the sheep on Mount Fyans Station, where they were in a most wretched state, and had been scabby for more than three years, and that, too, in both cases, without destroying a single hurdle or yard or removing any of the sheep from their old runs.

Since then millions of scabby sheep have been permanently cured in Victoria in the same way, and in South Australia and New South Wales hundreds of thousands of scabby sheep have also been cleansed with tobacco and sulphur. In fact, this dressing has the credit of having eradicated scab from the flocks of both the latter colonies, and there are good grounds for asserting that had this remedy not been known and used neither colony would be, as they both are now, almost entirely free from the scourge. Judging therefore from the experience of the three colonies, there is no medicament or specific yet known [1884] that can be compared with tobacco and sulphur as a thorough and lasting cure for scab in sheep.

The proportions adopted by Rutherford, and afterwards made official by the scab sanitary authorities, are:

Tobacco leaves	pound..	1
Flowers of sulphur	do...	1
Water (original formula, 5 gallons imperial, equivalent to 6 United States gallons).....	gallons..	6

The advantage of this dip lies in the fact that two of the best scab remedies, namely, tobacco (nicotine) and sulphur, are used together, both of which kill the parasites, while the sulphur remains in the wool and protects for some time against reinfection. As no caustic is used to soften the scab, heat must be relied on to penetrate the crusts.

Directions for preparing tobacco-and-sulphur dip.—The tobacco-and-sulphur dip is prepared as follows:

A. *Infusing the tobacco.*: Place 1 pound of good leaf or manufactured tobacco for every 6 gallons of dip desired in a covered boiler of cold or lukewarm water and allow to stand for about twenty-four hours; on the evening before dipping bring the water to near the boiling point (212° F.) for an instant, then remove the fire and allow the infusion to stand over night.

B. Thoroughly mix the sulphur (1 pound to every 6 gallons of dip desired) with the hand in a bucket of water to the consistency of gruel.

C. When ready to dip, thoroughly strain the tobacco infusion (A) from the leaves by pressure, mix the liquid with the sulphur gruel (B), add enough water to make the required amount of dip and thoroughly stir the entire mixture.

All things considered, the tobacco-and-sulphur is as good a dip as is known at the present time.

See also the discussion of the tobacco dips on page 28.

LIME-AND-SULPHUR DIPS.

Various formulas for lime-and-sulphur dips.—Under the term “lime-and-sulphur dips” are included a large number of different formulas requiring lime and sulphur in different proportions. In general prac-

tice all of these dips are spoken of as "the lime-and-sulphur dip," but in reality each separate formula represents a separate dip.

To give an idea of the variety of the lime-and-sulphur dips, the following list is quoted, the ingredients being reduced in all cases to avoirdupois pounds and United States gallons:

1. The original "Victorian lime-and-sulphur dip" proposed by Dr. Rowe, adopted as official in Australia:

Flowers of sulphur	pounds..	20 $\frac{5}{6}$
Fresh slaked lime	do....	10 $\frac{5}{12}$
Water	gallons..	100
2. South African (Cape Town) official lime-and-sulphur dip:

Flowers of sulphur (minimum)	pounds..	15
Unslaked lime	do....	15
Water	gallons..	100
3. South African (Cape Town) official lime-and-sulphur dip, February 4, 1897:

Flowers of sulphur	pounds..	20 $\frac{5}{6}$
Unslaked lime	do....	16 $\frac{2}{3}$
Water	gallons..	100
4. Nevada lime-and-sulphur dip:

Flowers of sulphur	pounds..	16 $\frac{2}{3}$
Lime	do....	33 $\frac{1}{3}$
Water	gallons..	100
5. Fort Collins lime-and-sulphur dip:

Flowers of sulphur	pounds..	33
Unslaked lime	do....	11
Water	gallons..	100
6. A mixture used extensively under the direction of this Bureau contains the same proportions of lime and sulphur (namely 1 to 3) as the Fort Collins dip, but the quantities are reduced to—

Flowers of sulphur	pounds..	24
Unslaked lime	do....	8
Water	gallons..	100

In case of fresh scab, Formula No. 6 will act as efficaciously as the dips with a greater amount of lime, but in cases of very hard scab a stronger dip, as the Fort Collins dip, should be preferred, or, in unusually severe cases, an ooze with more lime in proportion to the amount of sulphur, such as the Victorian (No. 1), the South African (No. 3), or the Nevada (No. 4) dip might be used.

Dangerous formulas.—Among the dangerous formulas for lime-and-sulphur dips are the following:

- a. California lime-and-sulphur dip:

Flowers of sulphur	pounds..	100
Lime	do....	25
Water	gallons..	100

A very dangerous misprinted formula is found in several books and journals, probably due to a typographical error, which specifies a much larger proportion of lime than any of those mentioned above. Thirty-

three pounds of lime to 100 gallons of water is the largest proportion admissible under any circumstances, and 16 $\frac{2}{3}$ pounds is as much as should be used without expert advice and supervision.

Many other formulas might be cited, but these are enough to show the great variations in the dips which have been used, and to prove that when a party simply states that "lime and sulphur" is an excellent dip, or that it is a dangerous dip, or that he has succeeded or failed with it, or that the lime-and-sulphur dip is injurious to the wool, his statements can not be taken as definite, unless he also states which lime-and-sulphur dip he used and how he used it.

Prejudice against lime-and-sulphur dips.—In the first place, it is frequently asserted that lime and sulphur does not cure scab. Experience in Australia and South Africa, as well as in this country, has shown beyond any doubt that a lime-and-sulphur dip, when properly proportioned, properly prepared, and properly used, is one of the best scab eradicators known. Cases of its failure have been due to careless or improper methods of its preparation and use.

It is also claimed by some that it produces "blood poisoning." The cases of death following the use of lime-and-sulphur dips have been infinitesimally few, considering the number of sheep dipped in these solutions, when compared with the deaths which have been known to follow the use of certain proprietary dips. The details of such accidents, so far as they have been reported, have not shown that death was due to any properly prepared and properly used lime-and-sulphur dip. If the formula of 100 pounds of sulphur, 150 pounds of lime, and 100 gallons of water has killed animals, that is no argument against the formula 33 pounds of sulphur, 11 pounds of lime, and 100 gallons of water, but simply shows that the former formula is too strong. The statement is frequently made that "shear-cut" sheep die when dipped immediately after shearing in a lime-and-sulphur dip which has stood for some time. It is highly probable that the cases of so-called "blood poisoning" of shear-cut sheep are generally due to an infection of bacteria in stale dip containing putrefying material. It is, therefore, safer to use a fresh supply of dip and to allow a short time to elapse after shearing before dipping. Some cases of death are also said to have occurred after using a lime-and-sulphur dip made in brass kettles.

In an experiment by the Bureau of Animal Industry, 5 c. c. of a clear lime-and-sulphur ooze (Formula No. 6) has been injected under the skin of a sheep without producing any evil effects.

It is also claimed that after the use of lime-and-sulphur dip ewes fail to recognize their lambs and lambs fail to recognize their mothers. This objection can, however, be made to other dips also.

The greatest objection raised against the use of lime-and-sulphur dip is that it injures the wool. After years of extensive experience

with properly prepared dip, its injury to the wool is strongly and steadfastly denied by the Agricultural Department of Cape Colony. It is, however, believed that there is a certain amount of justice in this objection to lime and sulphur as generally used; unless, therefore, lime and sulphur can be used in a way which will not injure the wool to an appreciable extent, we should advise against its use in certain cases; in certain other cases the good accomplished far outweighs the injury it does.

An examination into this damage and its causes shows that the usual time for dipping sheep is shortly after shearing, when the wool is very short; whatever the damage at this time, it can be only slight and the small amount of lime left in the wool will surely do but little harm.

In full fleece, lime and sulphur will cause more injury. In Australia the deterioration was computed by wool buyers at 17 per cent, although in Cape Colony the Department of Agriculture maintains that if properly prepared, and if only the clear liquid is used, the sediment being thrown away, the official lime-and-sulphur formula will not injure the long wool. In our own experiments we have found some samples of wool injured by dipping, while on other samples no appreciable effect was noticeable.

It must not be forgotten that other conditions, such as variations in the feed, pasturing on alkaline land, ill health from any cause, etc., may cause brittleness of the wool, which might be mistaken for the effects of lime and sulphur.

If a lime-and-sulphur dip is used, care must be taken to give the solution ample time to settle; then only the clear liquid should be used, while the sediment should be discarded. In some of our tests on samples of wool we have found that the dip with sediment has produced very serious effects even when no appreciable effects were noticed on samples in the corresponding clear liquid.

Experience has amply demonstrated that a properly made and properly used lime-and-sulphur dip is one of the cheapest and most efficient scab eradicators known, but its use should be confined to flocks in which scab is known to exist, and to shorn sheep, with the exception of very severe cases of scab in unshorn sheep. It should only be used when it can be properly boiled and settled. The use of lime-and-sulphur dips in flocks not known to have scab, especially if the sheep are full fleeced, can not be recommended; in such cases tobacco, or sulphur and tobacco, is safer and equally good.

If a lime-and-sulphur dip is chosen, it is better for ordinary cases to use the solutions containing a small amount of lime and three times as much sulphur as lime, as the Fort Collins formula, 33 pounds of sulphur and 11 pounds of lime to every 100 gallons of water, or the Bureau

of Animal Industry formula (No. 6), 24 pounds of sulphur and 8 pounds of lime to 100 gallons of water, rather than the formula with a greater proportion of lime.

If the stronger solutions, as the Victorian formula (No. 1), or the present South African formula (No. 3), or the Nevada formula (No. 4) are used at all, their use should be confined to unusually severe outbreaks. Under no circumstances should the California formula (*a*, page 22) be used. It is too strong and is liable to kill the sheep.

Another objection raised to the use of lime and sulphur is the claim that the "shrinkage" in weight of the sheep after the use of these dips is greater than after the use of other dips. In reply to this objection, it can only be repeated that such has not been the experience of the Bureau of Animal Industry, nor was it the experience of Professor Gillette in his experiments in Colorado. The burden of proof for the opposite statement, with exact statistics, rests upon those who raise this objection.

Still another objection advanced against lime and sulphur is that its continued use year after year will gradually decrease the annual clip. Whether this objection be valid or not, it is scarcely necessary to discuss it in detail in this bulletin; for, in the first place, the average sheep raiser of this country does not keep the same sheep "year after year," but sends most of his sheep (breeding ewes and the rams excepted) to market. Hence there will usually be little opportunity to injure the wool of a given animal "year after year." In the next place, if lime and sulphur are properly used one year, so that the flock is freed from scab, and if reinfection be guarded against, it will not be necessary to resort again to lime and sulphur.

These objections have been reviewed somewhat in detail in order to place the facts, so far as obtainable, before the farmer. It is not particularly advised by the Department that lime and sulphur be used in this country in preference to sulphur and tobacco, or tobacco alone, or any other effective dip. In fact, it is hoped that within ten years there will be no further use for the lime-and-sulphur dips. At the same time, where it is a choice, on the one hand, between lime and sulphur, with a temporary slight deterioration in the value of wool, but an absence of scab, and, on the other hand, the use of a secret and ineffective patent dip, with the continual presence of scab, and hence permanent deterioration in wool, there can be no doubt that the decision should be in favor of lime and sulphur (properly prepared and properly used).

All things considered, where it is a choice between sacrificing the weight of sheep, and to some extent the color of the wool, by using tobacco and sulphur, and sacrificing the staple of the wool by using lime and sulphur, the farmer should not hesitate an instant in selecting

tobacco in preference to lime. The loss in weight by using tobacco and sulphur is not much greater than the loss in using lime and sulphur, while the loss in staple is of more importance than a slight discoloration.

Preparation of lime-and-sulphur mixture.—Almost as many different methods of preparing the liquid exist as there are different formulas, some of the methods laying great stress upon sifting both the lime and the sulphur, others laying great stress upon allowing the liquid to settle, others leaving out of consideration both of these points. The method which has been found in the Department to be the easiest and most satisfactory is as follows:

A. Take 8 to 11 pounds of unslaked lime, place it in a mortar box or a kettle or pail of some kind, and add enough water to slake the lime and form a "lime paste" or "lime putty."

Many persons prefer to slake the lime to a powder, which is to be sifted and mixed with sifted sulphur. One pint of water will slake 3 pounds of lime, if the slaking is performed slowly and carefully. As a rule, however, it is necessary to use more water. This method takes more time and requires more work than the one given above, and does not give any better results. If the boiled solution is allowed to settle the ooze will be equally as safe.

B. Sift into this lime paste three times as many pounds of flowers of sulphur as used of lime, and stir the mixture well.

Be sure to weigh both the lime and the sulphur. Do not trust to measuring them in a bucket or to guessing at the weight.

C. Place the sulphur-lime paste in a kettle or boiler with about 25 to 30 gallons of boiling water, and boil the mixture for two hours at least, stirring the liquid and sediment. The boiling should be continued until the sulphur disappears, or almost disappears, from the surface; the solution is then of a chocolate or liver color. The longer the solution boils the more the sulphur is dissolved, and the less caustic the ooze becomes. Most writers advise boiling from thirty to forty minutes, but the Bureau obtains a much better ooze by boiling from two to three hours, adding water when necessary.

D. Pour the mixture and sediment into a tub or barrel placed near the dipping vat and provided with a bunghole about 4 inches from the bottom and allow ample time (two to three hours, or more if necessary) to settle.

The use of some sort of settling tank provided with a bunghole is an absolute necessity, unless the boiler is so arranged that it may be used both for boiling and settling. An ordinary kerosene oil barrel will answer very well as a small settling tank. To insert a spigot about 3 to 4 inches from the bottom is an easy matter. Draining off the liquid through a spigot has the great advantage over dipping it out,

in that less commotion occurs in the liquid, which therefore remains freer from sediment.

E. When fully settled, draw off the clear liquid into the dipping vat and add enough warm water to make 100 gallons. The sediment in the barrel may then be mixed with water and used as a disinfectant, *but under no circumstances should it be used for dipping purposes.*

A double precaution against allowing the sediment to enter the vat is to strain the liquid through ordinary bagging as it is drawn from the barrel.

In watching the preparation of lime-and-sulphur dips by other parties, the Bureau investigators have found some persons who laid great stress upon stirring the sediment well with the liquid before using the ooze. This custom is undoubtedly responsible for a great deal of the prejudice which exists at present against lime-and-sulphur dips; and, considering the preparation of these dips in this way, there is no wonder at the immense prejudice against them in certain quarters.

Position of the Bureau on lime-and-sulphur dips.—To summarize, the position of the Bureau of Animal Industry on the lime-and-sulphur dips is as follows: When properly made and properly used, these dips are second to none and equaled by few as seab eradicators. There is always some injury to the wool resulting from the use of these dips, but when properly made and properly used upon shorn sheep it is believed that this injury is so slight that it need not be considered; on long wool the injury is greater and seems to vary with different wools, being greater on a fine than on a coarse wool. This injury consists chiefly in a change in the microscopic structure of the fiber, caused by the caustic action of the ooze. When improperly made and improperly used the lime-and-sulphur dips are both injurious and dangerous, and in these cases the cheapness of the ingredients does not justify their use. In case seab exists in a flock and the farmer wishes to eradicate it, he can not choose a dip which will bring about a more thorough cure than will lime and sulphur (properly made and properly used), although it will be perfectly possible for the farmer to find several other dips which will, when properly used, be nearly or equally as effectual as any lime-and-sulphur dip. There is no dip to which objections can not be raised.

POTASSIUM SULPHIDE DIP.

It has been proposed by several parties to use a potassium sulphide dip, and such a dip has been tried to some extent. As yet, however, judgment upon it must be reserved. Gillette tried a dip composed of 4½ pounds of potash lye, 16 pounds of flowers of sulphur, and 100 gallons of water, and promises further reports on its effectiveness. Sheep dipped in this liquid gained but 6 pounds, namely, the same as the sheep treated with carbolic dip (p. 31).

TOBACCO DIPS.

The active principle of tobacco, upon which the tobacco dips depend for their action, is a poisonous substance known as nicotine. This poison when applied to animals externally in too strong solutions may cause nausea, fainting, and even death. The dog and the rabbit are particularly susceptible to its effects. Diluted to about thirty-three one-thousandths to sixty one-thousandths of 1 per cent it makes a slow but sure-acting and excellent sheep dip.

Unfortunately the percentage of nicotine varies greatly, not only in different kinds of tobacco, but also in different parts of the plant, in different years, and even in different parts of the same package. There is more nicotine in the leaves, for instance, than in the stems. In fermented tobacco there seems to be a certain relation between the amount of nicotine and the amount of juice present, so that in general dry, thin leaves do not contain so much nicotine as thick, "fat" leaves. The variation in percentage of nicotine in different kinds of tobacco is, according to Kissling, 1893, from 4.80 to 0.68. From four carloads of stems, aggregating 127,273 pounds, one American firm extracted 1,405.43 pounds of nicotine, or 1.104 per cent.

On account of the variation in the amount of nicotine in the different samples of tobacco, it is practically impossible for the farmer to make up an exact desired strength of tobacco dip if he prepares his own mixture from the leaves. He can, however, prepare a mixture which will come within the limits suited to kill the seab parasites. If a solution of an exact given strength is desired, it will be necessary to buy prepared nicotine, or prepared tobacco dips of a guaranteed strength, and reduce them to the strength determined upon.

To prepare the tobacco dip from the leaves it is best to use at least 21 pounds of leaves to every 100 gallons of water. Assuming that a tobacco leaf is used from which the farmer might extract 2 per cent of nicotine, the 100 gallons of ooze would contain slightly more than five-hundredths of 1 per cent; to obtain 100 gallons of ooze of thirty-three one-thousandths of 1 per cent strength, it would be necessary to use 21 pounds of tobacco yielding nearly 1.3 per cent nicotine.

Directions for preparing the dip.—For every 100 gallons of dip desired, take 21 pounds of good prepared tobacco leaves; soak the leaves in cold or lukewarm water for twenty-four hours in a covered pot or kettle; then bring the water to near the boiling point for a moment, and, if in the morning, allow the infusion to draw for an hour; if in the evening, allow it to draw over night; the liquid is next strained (pressure being used to extract as much nicotine as possible from the wet leaves) and diluted to 100 gallons per 21 pounds of tobacco. This dip should be used as fresh as possible, as it contains a large amount of organic material which will soon decompose.

The proportions here given—21 pounds of prepared tobacco leaves to 100 gallons of water—have given very satisfactory results, especially in Cape Town colony, where the reports of the scab inspectors accord this homemade tobacco dip third place among the dips officially recognized. In regard to one of the proprietary tobacco dips the Cape Town Agricultural Department reports as follows:

Highly spoken of by several inspectors. Very efficacious, and improves the quality of the wool, making it soft and pliable. The one thing which militates against its general use is its expense, hindering the poorer farmers from using it. It is allowed to be one, if not the best, of the patent dips in use, and also the safest.

By all means the use of a tobacco dip, or of the tobacco-and-sulphur dip, in preference to the lime-and-sulphur dips is advised in case the sheep to be dipped show no unmistakable signs of scab.

At present most tobacco dips are made either with the extract of tobacco or with nicotine solution, on account of the convenience of mixing these preparations with water. The regulations of the Bureau of Animal Industry call for 0.05 of 1 per cent of nicotine in a tobacco dip. Sufficient nicotine would therefore be furnished for 100 gallons (about 800 pounds) of dip by 1 pound of a 40 per cent solution of nicotine. The formula for this dip would be:

Nicotine	pound..	0.4
Flowers of sulphur.....	pounds..	16
Water	gallons..	100

The sulphur should be made into a thin paste with water in a bucket before it is added to the dip in the tank. It can then be poured in slowly with continual stirring, and will not settle to the bottom, as would otherwise be the case. The nicotine solution or tobacco extract should not be added to the dip until just before it is ready for use, and then the dip should be thoroughly stirred, so as to secure a uniform mixture. The dip should on no account be heated above 110° F. after the nicotine solution is added, as heat is liable to evaporate the nicotine and weaken the dip. It will be an easy matter to calculate how much nicotine solution or extract of tobacco should be used for 100 gallons of water by dividing the quantity of nicotine required in the dip by the proportion of nicotine in the extract. For example, suppose the nicotine solution contains 25 per cent of nicotine, we have $0.40 \div 0.25 = 1.6$. Therefore in this case it would require 1.6 pounds of nicotine solution for the 100 gallons of dip. Or, if a tobacco extract is used, having, for example, 2.40 per cent of nicotine, the formula would be as follows: $0.40 \div 0.024 = 16.66$, and therefore 16.66 pounds would be required for 100 gallons of dip.

The advantages of the tobacco dip are that it is comparatively cheap, since the farmer can grow his own tobacco; that it is effectual and at the same time not injurious to the wool. The disadvantages of the

dip are that it sometimes sickens the sheep; that it also occasionally sickens the persons who use it, especially if they are not smokers; it spoils very rapidly; it causes a greater setback, or "shrinkage," than lime and sulphur, but less of a setback than carbolic dips.

ARSENICAL DIPS.

There are both homemade arsenical dips and secret proprietary arsenical dips. It is well to use special precautions with both because of the danger connected with them. One of the prominent manufacturers of dips, a firm which places on the market both a powder arsenical dip and a liquid nonpoisonous dip, recently summarized the evils of arsenical dips in the following remarkable manner:

The drawbacks to the use of arsenic may be summed up somewhat as follows: (a) Its danger as a deadly poison. (b) Its drying effect on the wool. (c) Its weakening of the fiber of the wool in one particular part near the skin, where it comes in contact with the tender wool roots at the time of dipping. (d) Its not feeding the wool or stimulating the growth, or increasing the weight of the fleece, as good oleaginous dips do. (e) The danger arising from the sheep pasturing, after coming out of the bath, where the wash may possibly have dripped from the fleece, or where showers of rain, after the dipping, have washed the dip out of the fleece upon the pasture. (f) Its occasionally throwing sheep off their feed for a few days after dipping, and so prejudicing the condition of the sheep. (g) Its frequent effect upon the skin of the sheep, causing excoriation, blistering, and hardness, which stiffen and injure the animal, sometimes resulting in death.

Although this manufacturer has gone further in his attack upon arsenic than the Bureau of Animal Industry would have been inclined to do, it must be remarked that when a manufacturer of such a dip can not speak more highly of the chief ingredient of his compound than this one has done in the above quotation, his remarks tend to discredit dips based upon that ingredient. It might be added that Bruce, the chief inspector of live stock for New South Wales, says, in respect to arsenical dips, that "arsenic and arsenic and tobacco (with fresh runs) cured 9,284 and failed with 9,271."

It may be said, on the other hand, that arsenic really has excellent scab-curing qualities; it enters into the composition of a number of the secret dipping powders and forms the chief ingredient in one of the oldest secret dips used. This particular dip has been given second place (with some qualifications) among the officially recognized dips in South Africa. In deference to the opinion of those who prefer an arsenical dip several formulas are quoted here.

Formulas for arsenical dips.—Finlay Dun recommends the following: Take 3 pounds each of arsenic, soda ash (impure sodium carbonate) or pearl ash (impure potassium carbonate), soft soap, and sulphur. A pint or two of naphtha may be added if desired. The ingredients are best dissolved in 10 to 20 gallons of boiling water, and cold water is

added to make up 120 (United States) gallons. The head of the sheep must, of course, be kept out of the bath.

A mixture highly indorsed by certain parties consists of the following ingredients:

Commercially pure arsenite of soda	pounds..	14
Ground roll sulphur.....	do....	34 $\frac{1}{2}$
Water.....	gallons (U. S.) ..	432

The arsenite of soda is thoroughly mixed with the sulphur before being added to the water.

Precautions in use of arsenical mixtures.—Any person using an arsenical dip should bear in mind that he is dealing with a deadly poison. The following precautions should be observed:

(1) Yards into which newly dipped sheep are to be turned should first be cleared of all green food, hay, and even fresh litter; if perfectly empty they are still safer. (2) When the dipping is finished, the yard should be cleaned, washed, and swept, and any unused ooze should at once be poured down a drain which will not contaminate food or premises used by any animals. (3) Dipped sheep should remain in an open, exposed place, as on dry ground. (4) Overcrowding should be avoided, and every facility given for rapid drying, which is greatly facilitated by selecting fine, clear, dry weather for dipping. (5) On no account should sheep be returned to their grazings until they are dry and all risk of dripping is passed.

Suggestion as to danger.—The arsenical formulas given above are copied from the writings of men who have had wide experience in dipping, but this Department assumes no responsibility for the efficacy of the dips given or for their correct proportions. Furthermore, as long as efficacious nonpoisonous dips are to be had, there is no necessity for running the risks attendant upon the use of poisonous dips.

CARBOLIC DIPS.

A carbolic-acid dip may be made at home or may be purchased as a proprietary article. This class of dips kills the seab mites very quickly, but unfortunately the wash soon leaves the sheep, which is consequently not protected from reinfection in the pastures. If, therefore, a carbolic dip is selected, it is well to add flowers of sulphur (1 pound to every 6 gallons) as a protection against reinfection.

The advantages of carbolic dips are that they act more rapidly than the tobacco or sulphur dips, and that the prepared carbolic dips are very easily mixed in the bath. They also seem, according to Gillette, to have a greater effect on the eggs of the parasites than either the sulphur or the tobacco dips. The great disadvantages of this class of dips are, first, in some of the proprietary dips, that the farmer is uncer-

tain regarding the strength of material he is using; second, the sheep receive a greater setback than they do with either lime and sulphur or tobacco.

Gillette reports most excellent results from the use of a certain prepared carbolic dip. The Department purchased the same dip upon the open market and tested its effects upon the sheep in the proportion recommended by the manufacturer on the label of the package and also in one-half and one-third that strength. In the first and second tests the dip was severe both on the sheep and on the operators. In one case it caused a considerable, though temporary, eruption on the hands and arms of an operator. In all three cases the dipped sheep were almost overcome in the dipping tank, and upon recovering themselves ran around the field in an excited manner, bleating loudly, and shaking their heads and tails. The eyes were more congested than the writers have ever seen them to be after a lime-and-sulphur or a tobacco dip.

An objection to some of the proprietary carbolic dips is that the manufacturers themselves apparently are little acquainted with their own mixtures. Their claims are extravagant and their directions often contradictory. It may be admitted that the carbolic dips are promising and that they may have a brilliant future, but they have not had a very brilliant past, and this Department is inclined to be extremely conservative in regard to them and to advise their manufacturers to prepare them in a guaranteed strength with more explicit directions for use than are to be found in the present circulars. The dip just referred to was certainly more severe in its effects on the sheep than can be justified by its quick action in killing the seab parasites, considering that other equally effective but milder solutions are to be had.

It was also found in the tests (which are not yet fully completed) that the sheep gained less in weight when dipped in certain two of these washes than when dipped in lime and sulphur, or in sulphur and tobacco, or in tobacco.

If a carbolic dip is used care must be taken that the ingredients form a thorough emulsion; if a scum arises to the top, a softer water should be used.

In justice to this class of dips it is only fair to state that while the views here expressed are entirely in accord with the opinions of some authorities, they do not agree with the views held by others; but they are based upon the material purchased in open market, and probably represent the experience of many who have used these dips. The investigations of the Bureau of Animal Industry certainly show that more tests are necessary before this class of dips can be indorsed. It is hoped that these tests may be made in the near future.

One of the prominent proprietary carbolic dips was formerly recog-

nized as one of the three official dips in New South Wales, but it has now been stricken from the list. In Cape Town carbolic dips are not much used, and in the official reports little is said concerning them.

SETBACK TO THE SHEEP FROM DIPPING.

Dipping often results in a slight setback. If sheep are weighed immediately before dipping, and again at the same hour the following day, it will be noticed that the weight has changed. There may be a gain, but usually there is a loss varying from $\frac{1}{2}$ to $3\frac{1}{2}$ pounds. The second day there may also be either a gain or loss. As the weight of sheep varies from day to day, from 1 to 5 pounds in loss or gain, due chiefly to the increase or decrease of the amount of fodder and water in the stomach, the effects of dipping can not be estimated in twenty-four or forty-eight hours. In order to meet statements made concerning loss or gain in weight, the Bureau of Animal Industry had sheep dipped at stated intervals and the weights taken from week to week; all the sheep were kept under exactly the same conditions; the dips used were lime and sulphur, tobacco and sulphur, and two proprietary carbolic dips.

At the end of about two months, after three dippings, all of the sheep showed a gain, with the exception of one of the sheep from the carbolic dip, which lost slightly. The lowest gain among the sheep treated with tobacco dip was $3\frac{1}{2}$ pounds, the highest $11\frac{1}{2}$ pounds. The lowest gain among the sheep treated with lime and sulphur was 7 pounds, the highest $8\frac{1}{2}$ pounds. The lowest gain among the sheep treated with the carbolic dip was $1\frac{1}{2}$ pounds, the highest $3\frac{1}{2}$ pounds, while one animal lost $\frac{1}{2}$ pound. The sheep were given a fourth dipping, and at the end of another month showed the following gains and losses over their original weight at first dipping: Sheep treated with tobacco, 9 to 15 pounds gain; sheep treated with lime and sulphur, $11\frac{1}{2}$ to 14 pounds gain; sheep treated with carbolic dip, 1 to $6\frac{1}{2}$ pounds gain, in one case $13\frac{1}{2}$ pounds lost.

The experiment was then repeated, the lime and sulphur being used on sheep previously dipped in carbolic or tobacco dips, and vice versa. After ten days the sheep treated with lime and sulphur had gained from 2 to 3 pounds; the sheep treated with tobacco had remained stationary, or had lost from 1 to $1\frac{1}{2}$ pounds; the sheep treated with carbolic dip had gained as high as 1 pound, or remained stationary, or had lost as much as $2\frac{1}{2}$ pounds. At this point circumstances intervened which closed the experiments for the season.

Gillette has also made determinations of the loss of weight of sheep from dipping. Part of his results agree with those of the Bureau and part differ. The chief point of difference in opinion is that Gillette

considers that the best conclusion can be based upon weights taken a few days after dipping, while we consider the weight at a later period as the better criterion. Gillette gives weights from November 17 to

December 22, and, taking the cases where the sheep have been dipped twice, we see from his tables that the sheep treated with carbolic dip gained on an average 6 pounds, the sheep treated with tobacco gained 8 pounds, the sheep treated with arsenical dip gained 8 pounds, the sheep treated with lime and sulphur, which, unfortunately for the comparison, did not receive the same fodder as the others, gained 9 pounds, while the sheep

FIG. 8.—A simple caldron which may be used for boiling dip.

which were not dipped, in order to give a basis for comparison, gained 6 pounds.

Holding in mind that sheep may apparently gain or lose about 3

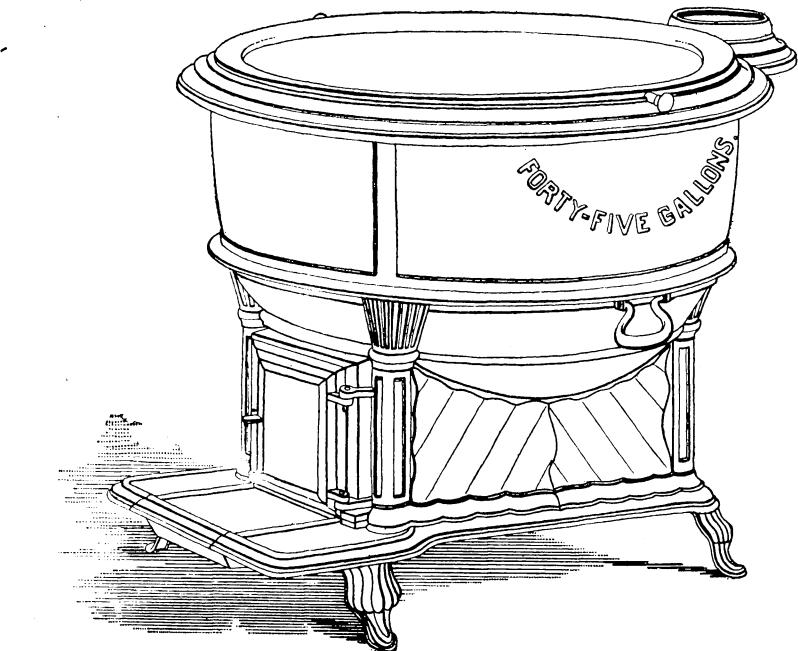


FIG. 9.—A caldron with stove.

pounds per day when not dipped, it is seen from the experiments by Gillette, in Colorado, and by this Bureau, in the District of Columbia, that the oft-repeated claim that lime-and-sulphur dips give a greater

setback than other dips is erroneous. In both the Western and the Eastern experiments the sheep treated with lime and sulphur averaged the greatest gain, the sheep treated with tobacco the second highest gain, while the sheep treated with carbolic dip showed the lowest gain.

DIPPING PLANTS.

There are numerous kinds of dipping plants in use, the size and style varying according to the conditions which are to be met and the individual taste of the owner.

The farmer who has but a small flock can use a small portable vat for dipping, turning a part of his barn or some shed into a catching pen; by holding the sheep a moment at the top of the incline, as the animals emerge from the vat, and allowing them to drain, he can do away with the necessity of a draining yard.

When large flocks are to be dipped at stated periods it will be economy to build a more permanent plant. Such a plant should consist of (1) collecting and forcing yards, provided with a (2) drive and (3) chute, or slide, into the (4) dipping vat, from which an (5) incline with cross cleats leads to the (6) draining yards.

Heating tanks or boilers are also necessary. For a small vat, any portable caldron (figs. 8 and 9) with a capacity of 30 to 100 gallons will answer, and the proper temperature may be maintained by pouring fresh hot ooze into the vat as the supply is exhausted by the dipping. In the large permanent plants the temperature can best be regulated by means of a steam pipe or hot water coil close to the floor of the tub.

Thermometers are an absolute necessity. The floating dairy thermometer (fig. 10) will be found to be most convenient, and several extra thermometers should be kept on hand to replace broken instruments. The thermometer is dropped into the vat and allowed to float for a short time, then quickly removed and the temperature determined. It is well to make paint marks at the side of the 100° and 110° points.

Building material.—The yards and vat may be built of wood, concrete, cemented stone, or brick, according to the individual taste of the owner and the facilities at hand.

Dimensions.—The dimensions of the various parts given in the following descriptions may be varied according to the breed and the number of sheep to be dipped. Dip-

ping liquid will be saved by making the tub much narrower on the bottom than at the top. On top, simple oblong dipping tanks vary from 1 foot 9 inches to 3 feet in breadth, 2 feet or 2 feet 6 inches forming a convenient medium. Floors vary from 6 inches to 3 feet in width, 9 inches forming a good working medium. Depth varies from 3 feet to 5 feet 6 inches, 4 feet to 5 feet forming a convenient medium. If calves are to be dipped in the same vat it will be best to make the tub 5 feet or 5 feet 6 inches deep.

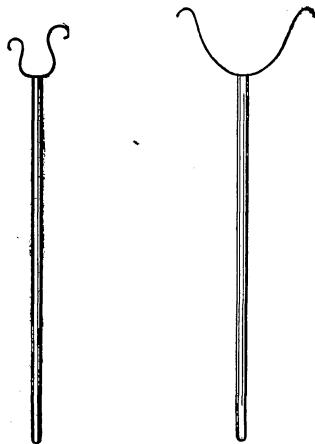


FIG. 11.—Two styles of crutch, or dipping fork (one on left from the Agricultural Journal, 1894, p. 261).

quarters inch half round. The form of the crutches is shown in fig. 11.

Gauges.—The capacity of tubs should be plainly marked on the side every 3 or 6 inches, in order to correctly measure the amount of liquid.

SMALL PORTABLE VATS FOR SMALL FLOCKS.

If no regular dipping vat is at hand, a good-sized tub may be used, as shown in fig. 12. Dipping in this manner is slow and tedious, but may be resorted to in case of necessity, as, for instance, when a few sheep are bought from another flock which is not known to be absolutely free from scab. If care is taken to dip thoroughly the dipping may be done as effectually in such a tub as it could be done in a large vat. Recourse to ordinary tubs is not advised, however, when it is possible to use regular dipping vats. Lambs may, in case of necessity, be dipped in troughs, as shown in fig. 13.

A small portable vat, suitable for use in dipping small flocks, is shown in fig. 14. When not in use this vat may be conveniently stored away. An advantage connected with this vat is that it may be drawn from place to place as desired. The dimensions here given may be varied, according to individual taste, by making the vat longer,

broader, or deeper. A convenient size will be 9 feet long by $2\frac{1}{2}$ feet broad at the top, 9 inches broad at the bottom, and $3\frac{1}{2}$ to 5 feet deep; the floor measures 9 inches broad by 4 feet long; from 1 foot above one end of the floor a slant with cross cleats rises to the top and end



FIG. 12.—Dipping sheep in a tub (from Stewart's *The Shepherd's Manual*, 1882, p. 47).

of the vat. The sheep are dropped in by hand, one at a time, at the deep end, and after being held in the dip for two minutes are allowed to leave the vat at the slanting end. They are held a moment on the slant to allow them to drain off, thus economizing in dip. A gate

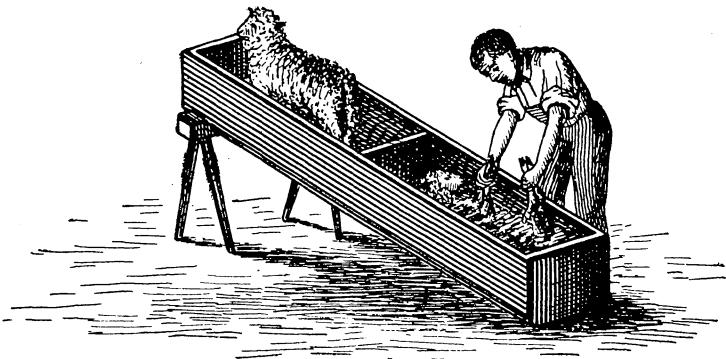


FIG. 13.—Trough for dipping lambs (from Stewart's *The Shepherd's Manual*, 1882, p. 48).

may be placed at the deeper part of the slant if desired, in order to save labor. This gate should swing toward the exit of the vat. Such a tank may be made of $1\frac{1}{2}$ inch pine boards, with tongue and groove, and should be well pitched or painted.

This plan of vat may be easily modified, if desired, so as to have a

small dripping platform attached, as shown in fig. 15. In this modified plan an inclined platform is added to the vat shown in fig. 14 and a

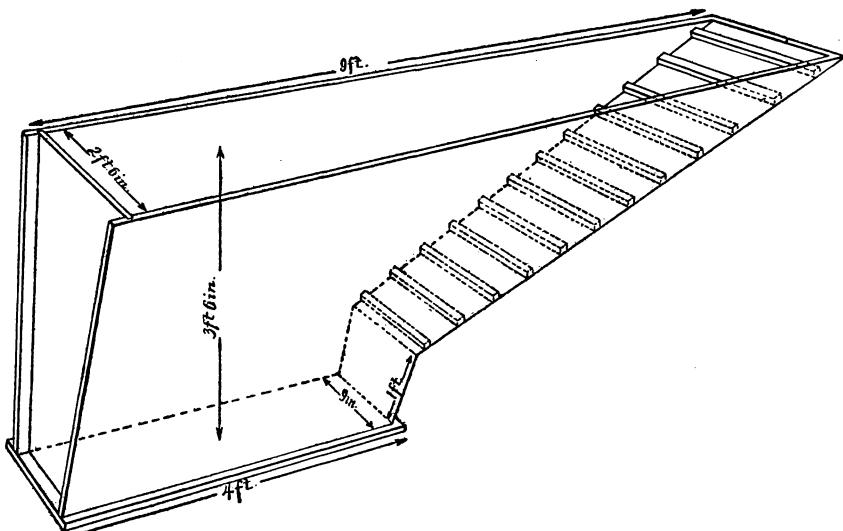


FIG. 14.—A small portable dipping vat for small flocks.

removable skeleton box is made to fit over it. While one sheep is being dipped another sheep is allowed to ascend the incline into the

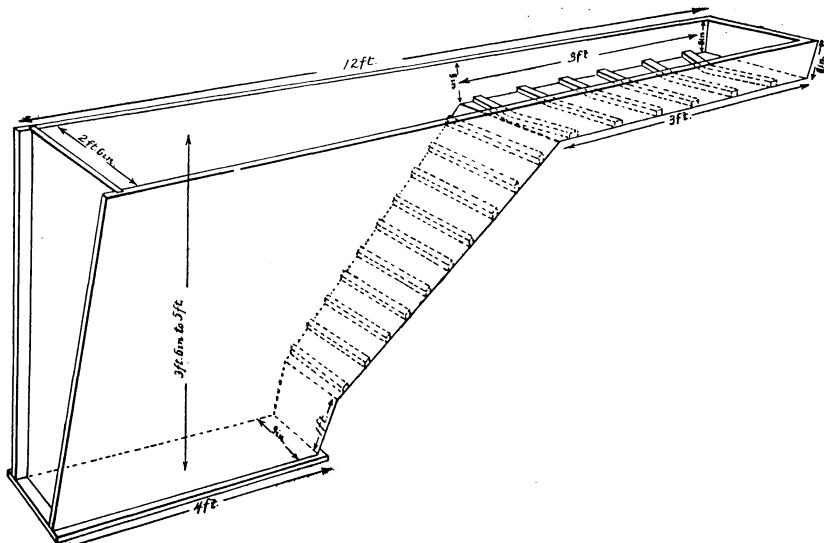


FIG. 15.—A small portable dipping vat with attached dripping platform.

small dripping pen. When the sheep is sufficiently drained the gate is opened, it leaves the pen, the gate is closed, the sheep in the vat enters the pen, and another sheep is placed in the vat.

DIPPING PLANTS WHICH CAN BE UTILIZED FOR LARGE FLOCKS.

Plants with receiving and forcing yards.—In Bulletin No. 21 (revised) many dipping plants, intended for large flocks of sheep, with receiving and forcing yards and chutes or slides, are illustrated and described; but in this publication only two plants will be shown, one (fig. 16) in which it is estimated 1,500 sheep may be dipped in a single day, and the other a plant used in Millard County, Utah, the details of which may be seen in fig. 17.

Where large numbers of sheep are to be dipped, receiving pens close to the dipping vat are necessary, and of course the number and size of the pens vary with the number of sheep to be handled. The yards may be either square or oblong, or they may be circular. The

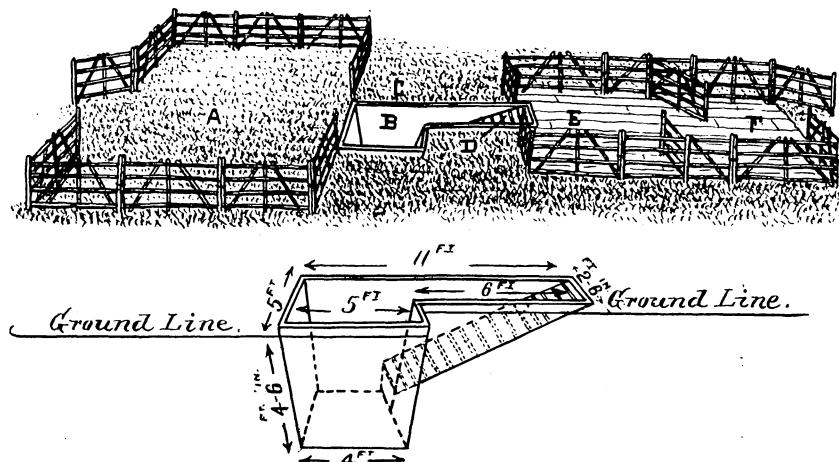


FIG. 16.—A small dipping plant: *A*, collecting yard; *B*, dipping vat; *C*, place for man with fork; *D*, incline, with cross cleats, to draining pens *E* and *F*. Lower diagram gives dimensions of the vat. (Copied from Sutherland's Sheep Farming, 1892.)

square or oblong yards are simple in construction, and need no other description than that furnished by the illustrations.

Dipping vats.—The dipping vat may be made on several different plans—the single oblong straight vat, the double or triple, with turns at the ends, the square or oblong. The single oblong dipping vat is shown, with details of construction, in fig. 17. In the use of this vat, suitable for holding three sheep at once, time will be saved in dipping if a long vat is used, so that the animals may swim directly through without stopping, and then leave the tank. The tank should be made about $2\frac{1}{2}$ feet broad at the top, 9 inches broad at the bottom, and 4 to 5 feet deep. The length may be 20 to 120 feet, as desired. One end (the entrance) should be straight, or with a steep slant, while the last 5 to 14 feet at the other end (exit) should have a gradual slant with cross cleats. Vats are in use varying from 10

to 120 feet long. Naturally, the longer the vat the more building material and ooze will be required.

The dripping pens.—There should be two dripping pens, side by side (*F, F*, fig. 17), with a swinging gate at the entrance; one pen is filled and the gate is then closed, opening the other pen; when the second pen is filled the first pen is emptied by allowing the sheep to pass out into a large lot; or the pens may be in direct line with the vat.

These pens should have a slight incline toward the tub, so that the dripping ooze will run back to the tub. A good plan is to build the

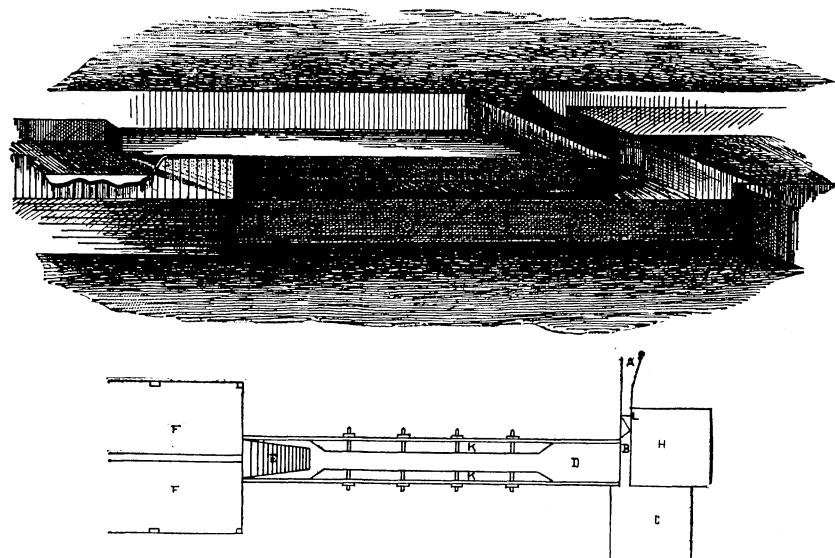


FIG. 17.—A dipping plant in use in Millard County, Utah: *A*, chute from the large corral; *B*, a sloping board over which the sheep in attempting to pass to the decoy pen, *C*, slide into the tank, *D*; *E*, board fastened in tank with cleats on it, to enable the sheep to obtain a foothold in walking out; *F, F*, draining pens (water tight), and sloping to sluice box in center, which carries the dip again into tank *D*; *H*, pen into which to dodge sheep not required to be dipped; *I*, dodge gate; *K, K*, two pieces, 2 by 6 inches and 12 feet long, bolted lengthwise of the tank, leaving a 12-inch space in the middle of the dip through which the sheep must put their heads, preventing those in rear from riding those in front, at the same time keeping their backs under the dip. (Copied from Powers' *The American Merino*, 1887, p. 308.)

incline from the sides toward the center fence; under the fence build a partially covered gutter inclining to the tub; the cover of the gutter should be removable to allow cleaning; at the end of the gutter nearest the tub place a grating to catch the wool and droppings, thus preventing these materials from being washed into the dip.

The incline to the dipping pens.—At the end of the vat an incline, with cross cleats, is built so that the sheep may leave the dip of their own accord and enter the draining pens. A board fence, 2 feet high above the top of the vat, should run a few feet each side of this incline, to prevent the sheep from escaping. The rise for fat, heavy wool

sheep must not be too steep, otherwise the exertion will be too great. Some inclines are 5 feet 9 inches in a surface distance of 14 feet 3 inches. At the Chicago Stock Yards the incline is 9 feet.

Much labor will be saved if a hinged or, still better, a sliding gate is placed at the deepest portion of the incline. The sheep may thus be held in the dip as long as desired; when the time is up the gate is opened and the sheep enter the draining pens.

Shelter and arrangements for cleaning the dipping plant.—The vat, boilers, and dripping pens should be under cover, and it will be well to extend the cover over the drive and the forcing pens.

Cleaning the plant may be facilitated if the following suggestions are observed: It is well to have one end of the vat slightly lower than the other end, so that the ooze will run toward that point when the tub is being emptied. If the entire floor of the collecting pens is made of brick, cement, or boards, and inclines slightly toward one or two points, the yards may be more easily cleaned by means of a hose and stream of water. If this plan is adopted there should be an upright baseboard or a solid wall of concrete or brick a few inches in height running around the edge of the entire pen. If there is direct sewer connection for the vat a trap or manhole should be made to catch the droppings and the tags of wool, otherwise the sewer pipe will become obstructed.

Boiling, infusing, and settling tanks.—The arrangement of the boiling tanks depends upon two factors in particular: First, upon the kind of dip used; second, upon the arrangement adopted for keeping the bath at the proper temperature.

In case a steam pipe is placed near the floor of the dipping vat in order to keep the ooze at its proper temperature while dipping, the vat itself may be used for heating water. Clear water is run into the vat and the steam turned on full force until the proper temperature is obtained. If a carbolic or a prepared tobacco dip is used, the material may then be mixed in the vat if desired. Even in this case, however, it is best to provide a separate boiling tank for heating and preparing fresh ooze to replace the dip as it is used up.

These boiling tubs may be made of wood or iron, according to the facilities at hand. If steam is to be had, the square or round wooden boiling tub may be used, and an open steam pipe run into it to heat the water. If the steam pipe can not be used, either in the vat or in the boiling tanks, iron tanks should be provided. The iron tanks are set in brick or stone frames, with a fireplace below. It is best to have two tanks, each with a capacity of about 400 gallons.

If a homemade tobacco dip is prepared from the leaves there should also be provided two iron infusing caldrons, each with a cover and with a capacity of 80 to 120 gallons. The infusion is prepared in these

smaller tanks, while the bulk of the water is heated in the boiling tanks or in the swim itself.

If a lime-and-sulphur dip is used, it is absolutely necessary to provide some means for settling the mixture, in order that the bath may be free from sediment. This may be done in two ways. The better way is to have separate settling tubs provided with bungholes or pipes 3 or 4 inches from the bottom. After the mixture is thoroughly boiled it is pumped into the settling tubs and allowed to remain there until it is perfectly free from sediment; the clear liquid is then run into the dipping vat and diluted with warm water to the proper strength. Or the boiling tanks may also be used as settling vats. A pipe with elbow joint is run into the boiling tank 3 or 4 inches above the bottom; the opening of the pipe should point sidewise, not up. After boiling the proper length of time the fire is removed and the liquid allowed to stand until clear; only the clear ooze is drawn off, the sediment remaining on the floor of the boiling tank.

Measures and pumps.—The capacity of the vat should be marked at different depths. The capacity of the boilers should also be marked in the same way. If these are marked for every 100, 200, 300, or 500 gallons (according to the amount of dipping to be done), separate measuring tanks will be unnecessary. In case the tanks are not marked a separate measuring tank should be provided.

If a homemade tobacco dip or a lime-and-sulphur dip is used, a set of scales is necessary. To guess at weights in mixing lime and sulphur may result in too strong a dip.

A portable pump will be found of great use in filling and emptying tanks.

FEDERAL LAWS AND REGULATIONS RELATIVE TO SHEEP SCAB.

As the scab of the sheep is unquestionably a contagious disease, it is unlawful to ship sheep so affected from any State, Territory, or the District of Columbia into any other State, Territory, or the District of Columbia. The penalties for such shipment of diseased sheep are heavy, as will be seen from an examination of sections 6 and 7 of the act approved May 29, 1884, which are as follows:

SEC. 6. That no railroad company within the United States, or the owners or masters of any steam or sailing or other vessel or boat, shall receive for transportation or transport, from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, any live stock affected with any contagious, infectious, or communicable disease, and especially the disease known as pleuro-pneumonia; nor shall any person, company, or corporation deliver for such transportation to any railroad company, or master or owner of any boat or vessel, any live stock, knowing them to be affected with any contagious, infectious, or communicable disease; nor shall any person, company, or corporation drive on foot or transport in private conveyance from one State or Territory to another, or

from any State into the District of Columbia, or from the District into any State, any live stock, knowing them to be affected with any contagious, infectious, or communicable disease, and especially the disease known as pleuro-pneumonia: *Provided*, That the so-called splenetic or Texas fever shall not be considered a contagious, infectious, or communicable disease within the meaning of sections four, five, six, and seven of this act, as to cattle being transported by rail to market for slaughter, when the same are unloaded only to be fed and watered in lots on the way thereto.

Sec. 7. That it shall be the duty of the Commissioner of Agriculture to notify, in writing, the proper officials or agents of any railroad, steamboat, or other transportation company doing business in or through any infected locality, and by publication in such newspapers as he may select, of the existence of said contagion; and any person or persons operating any such railroad, or master or owner of any boat or vessel, or owner or custodian of or person having control over such cattle or other live stock within such infected district, who shall knowingly violate the provisions of section six of this act, shall be guilty of a misdemeanor, and, upon conviction, shall be punished by a fine of not less than one hundred dollars nor more than five thousand dollars, or by imprisonment for not more than one year, or by both such fine and imprisonment.

The provisions of this statute are very specific and clear, and there can be no possible doubt of their application to the disease under consideration. Congress has, nevertheless, gone still further by way of emphasizing this application, and has particularly directed the attention of the Department of Agriculture to a few important diseases, including sheep scab, by the following clause, which has been repeated in the appropriation act for a number of years:

* * * and the Secretary of Agriculture is hereby authorized to use any part of this sum he may deem necessary or expedient, and in such manner as he may think best, in the collection of information concerning live stock, dairy, and other animal products, and to prevent the spread of pleuro-pneumonia, tuberculosis, sheep scab, and other diseases of animals, and for this purpose to employ as many persons as he may deem necessary.

ACT OF FEBRUARY 2, 1903.

Acting in accordance with this legislation, the following orders have been made and promulgated by the Secretary of Agriculture, and are now in force:

(B. A. I. ORDER NO. 108.)

REGULATIONS TO PREVENT THE SPREAD OF SHEEP SCAB.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 3, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectious diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that a contagious disease known as scabies, or sheep scab, exists among sheep in the United States, and in

order to prevent the dissemination of said disease and to aid in its eradication, the following regulations are established and observance thereof required:

1. It is required of everyone intending to ship or to trail sheep to ascertain that the sheep are not affected with scabies and have not been exposed to the contagion thereof before offering them for transportation or before crossing State or Territorial boundaries. Transportation companies are required to provide cleaned and disinfected cars or other vehicles for the reception of sheep, and to refuse for shipment sheep whose freedom from disease and from exposure to contagion is in doubt. Sheep that are not affected with scabies and that have not been exposed to the contagion may be shipped or trailed without restriction, unless they are in a locality where inspection and certification are required before their removal therefrom.

2. Sheep that are affected with scabies, or that have been exposed to the contagion of scabies, either through contact with infected flocks or infected premises, pens, or cars, shall not be shipped or driven from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia, or into public stock yards or feeding stations, until they have been dipped in a mixture approved by this Department, except as provided in Rule 4.

3. Sheep that are affected with the disease may be shipped for immediate slaughter after one dipping, but if they are intended for feeding or stocking purposes they shall be held for a second dipping ten days after the first one. All of the sheep in a certain flock or shipment in which the disease is present shall be considered as affected with the disease.

4. Sheep that are not affected with the disease, but which have been exposed to the contagion, may be shipped for feeding or stocking purposes after one dipping, but may be shipped for immediate slaughter without dipping.

5. When affected sheep are shipped for slaughter after one dipping, and when exposed sheep are shipped for slaughter without dipping, the cars conveying them shall be marked on each side with a card bearing the words "Scabby Sheep," and said cards shall not be removed until the cars have been cleaned and disinfected.

6. The dips now approved are:

(a) The tobacco-and-sulphur dip, made with sufficient extract of tobacco or nicotine solution to give a mixture containing not less than five one-hundredths of 1 per cent of nicotine and 2 per cent flowers of sulphur.

(b) The lime-and-sulphur dip, made with 8 pounds of unslaked lime and 24 pounds of flowers of sulphur to 100 gallons of water. The lime and sulphur should be boiled together for not less than two hours, and all sediment allowed to subside before the liquid is placed in the dipping vat.

Either one of these dips may be used.

7. The dipping must be done carefully and the sheep handled as humanely as possible. The Department, however, assumes no responsibility for loss or damage resulting from the dipping, and those who wish to avoid any risks that may be incident to dipping at the stock yards, as well as to avoid liability to prosecution, should see that their sheep are free from disease before shipping them to market.

8. The sheep must be kept in the dip between two and three minutes and their heads be submerged at least once, though for but an instant at a time, and assistance must be rendered immediately if they appear to be strangling. The dip must be maintained at a temperature between 100° F. and 105° F. while the sheep are in it. It must be changed as soon as it becomes filthy, regardless of the number of sheep dipped in it, and in no case shall it be used when more than one week old. In emptying the dipping vat the entire contents must be removed, including all sediment and droppings or other foreign matter.

9. Suitable dripping platforms and drying pens shall be provided. In cold weather sheep shall not be dipped unless they can be kept in a warm pen until dry. Sheep shall not be loaded until they have become dry.

10. Where large numbers of sheep in a district are ready for transportation, inspectors of the Bureau of Animal Industry will make inspections and give certificates for sheep found free from disease and not to have been exposed to the contagion and for sheep dipped under their supervision. Certificates will also be given at feeding stations and stock yards where inspectors may be stationed.

11. Sheep shipped under a certificate are not guaranteed uninterrupted transit; for in the event of the development of scabies or exposure to it en route they shall be dipped before proceeding to their destination, and the cars or other vehicles, and the chutes, alleys, and pens that may have been occupied shall be cleaned and disinfected.

12. Public stock yards shall be considered as infected and the sheep yarded therein as having been exposed to the disease, and no sheep may be shipped out without being dipped, with the exception noted in Rule 4. Where, however, a part of the stock yards is set apart for the reception of uninfected shipments of sheep and is kept free from disease, sheep may be shipped from such part without dipping. If by chance affected sheep are introduced into such reserved part, they shall be immediately removed therefrom and the chutes, alleys, and pens used by them thoroughly cleaned and disinfected. No sheep may be shipped for feeding or stocking from any stock yards where an inspector of the Bureau of Animal Industry is stationed without a certificate of inspection or of dipping given by him.

13. Cars and other vehicles, yards, pens, sheds, chutes, etc., that have contained affected or exposed sheep shall be cleaned and disinfected immediately after the sheep are removed therefrom.

14. Cleaning and disinfection shall be done by first removing all litter and manure and then saturating the interior surfaces of the cars and the woodwork, flooring, and ground of the chutes, alleys, and pens with a 5 per cent solution of crude carbolic acid in water, with sufficient lime to show where it has been applied.

15. Violation of this order is punishable by a fine of not less than \$100 nor more than \$1,000, or by imprisonment not exceeding one year, or by both fine and imprisonment.

16. B. A. I. Orders No. 5 and No. 38 are hereby revoked.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER No. 5.)

TRANSPORTATION OF SHEEP AFFECTED WITH SCABIES.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 18, 1897.

To the managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved April 23, 1897, making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1898, you are hereby notified that the contagious disease known as sheep scab, or scabies of sheep, exists among sheep in the United States, and that it is a violation of the law to receive for transportation or transport any stock affected with said disease from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State. It is also a violation of the law for any person, company,

or corporation to deliver for such transportation to any railroad company, or master or owner of any boat or vessel, any sheep, knowing them to be affected with said disease; and it is also unlawful for any person, company, or corporation to drive on foot or transport in private conveyance from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, any sheep, knowing them to be affected with said disease. All transportation companies and individuals shipping, driving, or transporting sheep are requested to cooperate with this Department in enforcing the law for preventing the spread of the said disease. Inspectors of the Bureau of Animal Industry are directed to report all violations of this act which come to their attention.

In order to more effectually accomplish the object of the above-mentioned laws, it is hereby ordered that any railroad cars, boats, or other vehicles, which have been used in the transportation of sheep affected with said disease, shall be immediately cleaned and disinfected by the owners or by the transportation companies in whose possession said cars or vehicles may be at the time the animals are unloaded, by first removing all litter and manure which they contain, and then saturating the wood-work with a 5 per cent solution of crude carbolic acid in water. Inspectors of the Bureau of Animal Industry are directed to see that this order is carried into effect.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 38.)

REGULATIONS CONCERNING THE DIPPING OF SHEEP AFFECTED WITH SCABIES.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 20, 1899.

Whereas the shipment of live stock affected with any contagious, infectious, or communicable disease from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, is prohibited by the act of Congress approved May 29, 1884; and

Whereas the contagious disease of sheep known as scabies, or scab, exists in many parts of the United States, due notice of which was given in the Department order of June 18, 1897; and

Whereas some of the preparations in which diseased sheep have been dipped by owners and stock-yard companies, with the object of destroying the contagion and making legal the shipment of said sheep in interstate trade, have proved inefficient, and said sheep have disseminated the contagion, notwithstanding such treatment; and

Whereas the damage and losses from scabies in sheep have been in some sections very heavy and discouraging to those engaged in the sheep industry—

It is ordered, That from and after August 10, 1899, no sheep affected with scabies, and no sheep which have been in contact with others so affected, shall be allowed shipment from one State or Territory into another, or from any State into the District of Columbia, or from the District into any State, unless said sheep shall have first been dipped in a mixture approved by this Department.

The dips now approved are:

1. The tobacco-and-sulphur dip, made with sufficient extract of tobacco to give a mixture containing not less than five one-hundredths of 1 per cent of nicotine and 2 per cent flowers of sulphur.

2. The lime-and-sulphur dip, made with 8 pounds of unslaked lime and 24 pounds of flowers of sulphur to 100 gallons of water. The lime and sulphur should be boiled together for not less than two hours, and all sediment allowed to subside before the liquid is placed in the dipping vat.

The owner of the sheep is privileged to choose which one of the above-mentioned dips shall be used for his animals. The Department will instruct inspectors to enforce due care in dipping sheep, but it assumes no responsibility for loss or damage to such animals, and persons who wish to avoid any risks that may be incident to dipping at the stock yards should see that their sheep are free from disease before they are shipped to market.

J. H. BRIGHAM,
Acting Secretary.

Instructions have also been issued to inspectors to rigidly enforce the meat-inspection law and regulations relating to scab in sheep. Sheep in an advanced stage of scab are feverish and unfit for food, and their carcasses will be condemned. Shippers who forward animals for slaughter in this condition will be likely to lose heavily upon them, as they will be subject to quarantine and condemnation. This is an additional and important reason for curing affected animals before they leave the feeding place.

The laws and regulations which have been adopted for the control of sheep scab are necessary to prevent the spread of the disease and the losses which result from it. If disregarded they may prove inconvenient and expensive to shippers whose flocks are affected. The information given in this bulletin will aid in an intelligent and helpful compliance with these regulations and in avoiding delays and prosecutions which might otherwise occur.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

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 22. The Feeding of Farm Animals. Pp. 32.
 24. Hog Cholera and Swine Plague. Pp. 16.
 25. Peanuts: Culture and Uses. Pp. 24.
 27. Flax for Seed and Fiber. Pp. 16.
 28. Weeds: And How to Kill Them. Pp. 32.
 29. Souring and Other Changes in Milk. Pp. 23.
 30. Grape Diseases on the Pacific Coast. Pp. 15.
 31. Alfalfa, or Lucern. Pp. 24.
 32. Silos and Silage. Pp. 32.
 33. Peach Growing for Market. Pp. 24.
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 36. Cotton Seed and Its Products. Pp. 16.
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 60. Methods of Curing Tobacco. Pp. 16.
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 175. Home Manufacture and Use of Unfermented Grape Juice. Pp. 16.
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 177. Squab Raising.